STEPTOE & JOHNSON LLP

ATTORNEYS AT LAW

1330 CONNECTICUT AVENUE, N.W.
WASHINGTON, D.C. 20036-1795

(202) 429-3000
FACSIMILE: (202) 429-3902
TELEX: 89-2503

PHOENIX, ARIZONA
TWO RENAISSANCE SQUARE

TELEPHONE: (602) 257-5200
FACSIMILE: (602) 257-5299

STEPTOE & JOHNSON INTERNATIONAL
AFFILIATE IN MOSCOW, RUSSIA

TELEPHONE: (011-7-501) 258-5250
FACSIMILE: (011-7-501) 258-5251

PANTELIS MICHALOPOULOS*
(202) 429-6494
*Admitted in NY only.

EX PARTE OR LATE FILED

RECEIVED

NOV 29 1996

Federal Communications Commission
Office of Secretary

November 29, 1996

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, D.C. 20554

Re: Notice of *ex parte* presentation in RM-8811, ET Docket No. 95-183/ RM-8553, PP Docket No. 93-253, ET Docket No. 94-124, RM-8308

Dear Mr. Caton:

This letter will refer to the November 25, 1996 ex parte presentation of Motorola Satellite Systems, Inc. ("Motorola") in the above-referenced proceedings. Motorola has duly notified the Commission of this presentation by letter from its counsel dated November 25, 1996. Attached hereto please find a complete copy of one of the papers submitted with the November 25, 1996 letter, entitled: "The Advantages of Automatic Power Control in the Sharing between Fixed Service and the Fixed Satellite Service in the 38.6-40.0 GHz Band." One page of that paper was missing from the original submission.

No. of Copies rec'd 0+1
List ABCDE

Three originals and three copies of this letter and attachment hereto are being submitted for inclusion in the above-referenced proceedings (see 47 C.F.R. § 1.1206).

Respectfully submitted,

Pantelis Michalopoulos

Counsel for Motorola Satellite Systems, Inc.

cc: Donald Gips
Ruth Milkman
Cecily Holiday
Steve Sharkey
Damon Ladson

Annex

THE ADVANTAGES OF AUTOMATIC POWER CONTROL IN THE SHARING BETWEEN FIXED SERVICE AND THE FIXED SATELLITE SERVICE IN THE 38.6 - 40.0 GHZ BAND

1. INTRODUCTION

The M Star system has been designed to share with both Fixed Service and other Fixed Satellite Service systems. Under reasonable sharing rules, the M Star and the Fixed Service can both share this scarce spectrum resource.

The M Star system can share with Fixed Service if the terminals are coordinated. This is a common approach for sharing between FSS and FS systems. Motorola has proposed rules that would allow sharing without coordination. If a manufacturer would meet the rules, the equipment could be installed without coordination. Those who do not meet the rules would be required to coordinate. The choice is theirs.

The sharing rules are such that the existing licenses could meet the rules if they utilized Automatic Transmitter Power Control. The advantages of Automatic Power Control have been stated in the TIA/EIA Telecommunications System Bulletin TSB10F "Interference Criteria for Microwave Systems" which has been included as Appendix A of this document.

In Section 4.3.1 on Page 4-10 of this document it states:

> *"Automatic (or Adaptive) Transmit Power Control (ATPC) is a desirable feature of a digital microwave link that automatically adjusts transmitter output power based on path fading detected at the far-end receiver(s). ATPC allows the transmitter to operate at less than maximum power for most of the time. when fading conditions occur, transmit power will be increased as needed. ATPC is useful for extending the life of transmitter components, reducing power consumption, simplifying frequency coordination in congested areas, allowing additional up-fade protection, and (in some radios) increasing the maximum power output (improves system gain).*

2. Fixed Service Goals in the 38.6 - 40.0 Ghz Bands

Among the goals stated by the Fixed Service advocates in the 38 Ghz band are the following:

- Cost effective use of spectrum to serve large markets
- High frequency reuse
- High system reliability

It will be shown in the following paragraphs that ATPC will help the Fixed Service meet their goals.

3. Automatic Transmit Power Control in Digital Links

As stated in Section 1, TSB10-F states that; "Automatic (or Adaptive) Transmit Power Control (ATPC) is a desirable feature of a digital microwave radio link that automatically adjusts transmitter output power based on path fading detected at the radio receiver".

3.1 Link Availability will be Increased with ATPC

The link availability goal of the Fixed Service links is 99.999%. This corresponds to only 5.3 minutes per year. Obviously, an equipment failure would immediately cause this availability goal to not be achieved.

ATPC would reduce the transmit power therefore reducing the stress on a critical part in the transmitter. At these frequencies, solid state power amplifiers and low noise receivers must be implemented with expensive Gallium Arsenide MMIC technology. Reducing the temperature/time profile for these devices dramatically increases their MTBF. Therefore ATPC will enhance the system reliability. Enhancing system reliability will improve the link availability.

It well could be that, in the millimeter band for number of years, the availability of the links could be limited by equipment reliability rather than weather outages.

3.2 Total Life Cycle Cost will be Reduced with ATPC

As stated above, solid state power amplifiers must be implemented with expensive Gallium Arsenide MMIC technology. Reducing the temperature/time profile will increase the MTBF and therefore reduce the maintenance cost of an equipment failure.

The receiver design is also simplified as the dynamic signal range at millimeter frequencies would be reduced by up to 30 dB.

Although incorporating ATPC will increase the hardware cost, the reduced signal dynamic range of the receiver will reduce the hardware cost. It is estimated that the net increase in the hardware and installation cost will be less than 2%.

Considering the reduced maintenance cost due to the higher equipment reliability, the total life cycle cost will likely be reduced.

3.3 Coordination will be simplified by the use of ATPC

Use of ATPC will ease the coordination problem. Interference is caused by in-band signals and by out-of-band emissions into the adjacent band.

If the Fixed Service links do not use ATPC, the transmitters will have to be sized to operate with link margins in excess of 50 dB. These excessive transmitter powers will cause a severe potential for interference and therefore coordination problems. The use of ATPC significantly reduces the range over which an in-band signal will interfere with another Fixed Service receiver.

An even more significant effect of ATPC is on out-of-band spurious into the adjacent bands. Out-of-band spurious from ATPC transmitters are reduced as the components nominally operate in the linear mode which also reduces the out-of-band emissions into adjacent channel receivers. Therefore thhe interference is reduced both by the range effects and by the reduced out-of-band emissions

3.4 Spectral Efficiency is Improved by the Use of ATPC

A result of the reduced range for interference and the reduced out-of-band emissions into the adjacent channel, the spectral efficiency for high density systems with ATPC is greatly improved over that which may be achieved without ATPC.

4. Summary and Conclusions

As shown in the above paragraphs, the use of ATPC will enhance the reliability of the Fixed Service links with a potential for the decrease in life cycle costs. It will ease coordination and enhance the frequency reuse and therefore the spectral efficiency in the Fixed Service bands.

The 40/50 Ghz band is the last usable band for wideband satellites. The bands allocated for satellites below 37.5 Ghz are either fully licensed and utilized or are in great contention for licenses. The bands above 50 Ghz are effectively unusable for satellite due to the adverse propagation environment. The only available bands where truly wideband satellites systems may operate are therefore in the 40/50Ghz band.

APPENDIX B

A Design Approach for Implementing Automatic Transmitter Power Control in 38.6-40.0 GHz Fixed Service Equipment

1. Introduction

The following describes an approach for low cost implementation of ATPC in millimeter wave Fixed Service equipment. The approach is very simple and can be implemented at minimum cost.

2. Problem Statement:

Provide 50 dB of transmit signal level control to maintain link quality in the presence of rain fades while minimizing interference with other services in the same frequency band. Typical transmitter output into the antenna would be in the range of +17 dBm to -33 dBm. Typical modulation types are FSK, OQPSK, and QAM.

3. Implementation cost:

3.1 Link Quality Estimate and control loop.

This function is implemented with negligible cost in existing systems by use of software to compare the estimated symbol values to the actual values after forward error correction is performed. Alternatively, the quality estimate can be done by examining the variance of the symbols before decoding. The algorithm computes a link quality estimate and sends a message to the transmitter to adjust it's power level up or down as required to maintain link quality at a predetermined value.

3.2 Transmitter RF power control.

In the case of non-constant amplitude modulation, the RF power control should be implemented in a way that does not change the transmit amplifier linearity since that would degrade the spectral containment of the emission. Power adjustment by the simple expedient of bias variation on the transmit amplifier is likely to introduce nonlinearity and distortion. An attenuator can be employed either at the input or the output of the amplifier without changing linearity.

At the input, a PIN diode attenuator with 3 to 4 sections (diodes) can achieve 50 dB range at low cost. In this case the noise floor of the amplifier must not degrade signal quality when the signal is attenuated by 50 dB. A typical amplifier such as the Litton LMA 415 with 18 dB gain and a noise figure of 9dB results in a very acceptable C/N of 36 dB in a 50 MHz bandwidth.

A PIN diode attenuator at the output requires the transmitter amplifier to deliver about 2 dB more output power to overcome the minimum loss of the attenuator. This approach is less desirable since it may cause distortion by driving the amplifier into its compression region unless the amplifier is upgraded.

The cost of the PIN attenuator and its interface to the data link is less than 2% of the total material cost of the simplest Fixed Site transceiver.

4. Motorola Experience with Automatic Power Control in Millimeter Wave Terminals

Motorola has incorporated ATPC in its terminals on the Iridium Program which operate at 20 and 30 Ghz. It has also manufactured a point-to-point terminal for the U.S. Government which operated at 55 Ghz and incorporated a form of ATPC.

There is no question that a competent manufacturer can sucessfully incorporate ATPC into millimeter wave Fixed Service equipment at a minimum cost.

TIA/EIA TELECOMMUNICATIONS SYSTEMS BULLETIN

Interference Criteria for Microwave Systems

TSB10-F

TSB10-F
(Revision of TSB10-E)

JUNE 1994

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

TELECOMMUNICATIONS INDUSTRY ASSOCIATION
Representing the telecommunications industry in association with the Electronic Industries Association

consider the overall system noise objectives in parallel with the system reliability (outage) objectives. Most analog links require significant carrier level increases above threshold sensitivity just to achieve acceptable baseband signal-to-noise (*e.g.* >35 dB increase for 70 dB S/N in the worst message channel in an FM-FDM link).

4.3 Automatic Transmit Power Control in Digital Links

4.3.1 Introduction:

Automatic (or Adaptive) Transmit Power Control (ATPC) is a desirable feature of a digital microwave radio link that automatically adjusts transmitter output power based on path fading detected at the far-end receiver(s). ATPC allows the transmitter to operate at less than maximum power for most of the time. When fading conditions occur, transmit power will be increased as needed. ATPC is useful for extending the life of transmitter components, reducing power consumption, simplifying frequency coordination in congested areas, allowing additional up-fade protection, and (in some radios) increasing the maximum power output (improves system gain).

If the maximum transmit power in a ATPC link is needed for only a short period of time, a transmit power less than maximum may (if certain restrictions are met) be used when interference calculations are made into other systems. Many years of fading statistics have verified that fading on different physical paths is non-correlated, *i.e.* the likelihood of two paths in a given area being in a deep fade and thus sensitive to interference simultaneously is very small. Further, to allow for inevitable deep fading, microwave paths are designed with unfaded carrier-to-noise (C/N) and carrier-to-interference (C/I) ratios much greater than those required for high quality path performance. Since fading is non-correlated among paths, a short-term power increase by a path experiencing a deep fade will not reduce the C/I on other paths to an objectionable level. On a properly designed path, and one not affected by rain outage, ATPC-equipped transmitters will be at maximum power for a short period of time. However, because the maximum power is available when deep fades occur, CFM, threshold C/N, and C/I calculations into an ATPC link may assume the "Maximum Transmit Power" receive carrier level

ATPC has been successfully implemented in FCC Part 21 common carrier bands for several years, and, under FCC *ET Docket 92-9*, is now permitted under Part 94. Currently, there are two types of ATPC available. The "ramping" type increases power dB for dB with a fade greater than a certain depth. The "stepped" type increases power in a single step to maximum power when a fade exceeds a certain depth. Besides significantly aiding the frequency coordination process, ATPC also provides receiver up-fade overload protection due to the backed-off transmit power under normal signal level conditions.

4.3.2 ATPC recommendations for frequency coordination

During the coordination process, the ATPC user must clearly state that ATPC will be used. The transmit powers associated with an ATPC system included on the coordination notice are defined as follows:

Maximum Transmit Power	That transmit power that will not be exceeded at any time, used for CFM and path reliability (outage) computations, and for calculating the C/I into an ATPC system.
Coordinated Transmit Power	That transmit power selected by the ATPC system licensee as the power to be used in calculating interference levels into victim receivers.
Nominal Transmit Power	That transmit power at or below the coordinated power at which the system will operate in normal, unfaded conditions.

The Coordinated Transmit Power is restricted to a 0 to 10 dB range below the Maximum Transmit Power. The Nominal Transmit Power must be less than or equal to the Coordinated Transmit Power, with typical values ranging from 6 to 15 dB below the Maximum Transmit Power. The receive level at which the system either steps up or begins to increase (ramp up) the far-end transmit power (depending on the type of ATPC) is referred to as the ATPC Trigger Level. Because shallow fading characteristics are path dependent and unpredictable, at least a 10 dB fade must occur before the Coordinated Transmit Power is exceeded.

In order to claim a Coordinated Transmit Power less than the Maximum Transmit Power (ATPC feature is used), certain restrictions on the time that this power is exceeded must be met. Below about 12 Ghz, the expected annual time percentages should not exceed the limits shown in Figure 4-4 and provided in Table 4-2. These time percentages can be calculated by the applicable reliability calculations as shown in Section 4.2.3. First, the fade depth that causes the transmit power to exceed the Coordinated Transmit Power by a certain number of dB must be calculated. This fade depth is then substituted for the CFM in the reliability calculation. For a ramping ATPC system that uses a step increase in transmit power, a single calculation of the time that the fade depth to the ATPC trigger level is exceeded is all that is required. For an ATPC system that increases (ramps up the) power in a linear dB for dB fashion, calculations of the time that the Coordinated Transmit Power is exceeded and the time that the Maximum Transmit Power is reached are sufficient. Future ATPC systems that boost transmit power in some other way may require time percentage calculations for the entire range of transmit power in excess of the Coordinated Transmit Power.

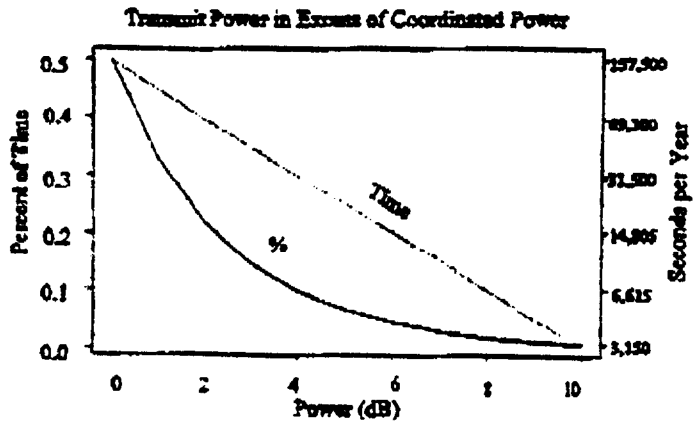

Figure 4-4 — Permitted Time Above Coordinated Transmit Power

In dB steps above the selected Coordinated Transmit Power for ramping-type ATPC systems, the permitted time percentages (and annual transmit power boost times) are shown in the following table. Only one single value (+6, +10 dB, *etc.*) need be considered in step-type ATPC systems (see examples in Section 4.3.3).